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This study was conducted to develop a methodology to enable direct cost Uniform Chart of Accounts (UCA) data to be expressed in terms of cost per disposition for specific Diagnosis Related Groups (DRG). Cost data were collected and compared under both accounting systems for completeness. The author concluded that the methodology for calculating average costs per DRG at military hospitals, using UCA supplied cost figures for each service and the HCFA DRG weights, is both practical and workable.

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A STUDY TO DEVELOP

A METHODOLOGY TO ENABLE DIRECT COST UCA DATA TO BE EXPRESSED IN TERMS OF COST PER ADMISSION FOR SPECIFIC DIAGNOSIS-RELATED GROUPS

A Graduate Research Project

Submitted to the Faculty of

Baylor University

In Partial Fulfillment of the

Requirements for the Degree

of

Master of Health Care Administration

by

Captain David K. Drury, MSC

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I. INTRODUCTION

Background to the Research Effort

The search for a workable method of capturing and identifying the costs associated with the provision of patient care in federal medical treatment facilities and displaying them in a usable format has been going on for a number of years. A major step in the right direction was the implementation of the Uniform Chart of Accounts (UCA) at all Department of Defense (DOD) fixed medical treatment facilities on October 1, 1979, culminating a development and testing effort which began in 1973.(1) The UCA was designed to provide a common basis for the determination and comparison of operating costs at a variety of military medical treatment facilities (MTFs). Essentially a cost-finding system, it measures units of workload and resources directly consumed for each clinical service in a given facility, and then through a series of allocation and assignment processes divides the remaining identifiable indirect and overhead expenses among the various clinic services at the facility according to a series of allocation units, or "performance factors." The end product is the apportionment by clinic service of the total cost of operating the facility during the time period covered by the report. When these derived total costs per (inpatient) clinic service are divided by the total patient bed days generated within the respective services, the result is an average cost per occupied bed day for each inpatient service in the facility.

Ostensibly, these average costs can then be compared among inpatient services in the same facility or among similar facilities at different locations. The practical value of such comparisons, however, depends upon the true comparability of the data. One of the major difficulties with such

a system is the lack of standardization in the patient care rendered (the product). Certain descrepancies become immediately obvious. For example, two services in the same facility which treat different types of patients (such as Dermatology and General Surgery) would show considerable disparity in their resource consumption patterns, and direct comparisons between the two might not be very informative. There are other discrepancies, perhaps more subtle, which could also cause the validity of direct comparisons to come into question. Two services falling under the same UCA code in two different facilities might, because of differences in their treatment capabilities or patient mixes, vary considerably in the nature and severity of the conditions treated, and therefore in the resources consumed in the process. Even the interpretation of average costs for a single service at a single facility is fraught with difficulties. Within Internal Medicine, for example, the range of patient conditions might run from heart attacks, which often receive intensive care and extensive follow-up support, to episodes of acute respiratory disease in basic trainees, which usually require only monitoring and minimal supportive care. Despite the wide disparity in the types and amounts of resources required to treat the two conditions, both could be included by the UCA in the same average cost per inpatient day. As a result, such a cost figure would be virtually meaningless, at least in isolation.

This inability to measure average costs against standardized reference products becomes a particular problem when matters of efficiency, definable in broad terms as the ratio between the results obtained and the resources consumed, are considered. It is possible for two facilities to treat exactly the same types and numbers of patients, account for them under the same services, and obtain nearly identical results in terms of patient outcomes, but to still differ in their utilization of resources. Suppose,

for example, that one facility were to vary from the other only in the length of stay, perhaps keeping its patients in the hospital an average of one or two days longer than the other. When the UCA calculations were completed, its average cost per occupied bed day (OBD) would be lower than that for the facility with the shorter length of stay. This would be so because the cost of the medical care rendered is generally considerably higher than the daily cost of boarding the patient; thus, when the former is spread over more days, the average daily cost decreases, even though the total cost has increased. The more efficient facility, which kept its patients in the hospital for less time (thus consuming fewer resources, overall) while achieving the same end result, would have lower total costs but a higher average cost per OBD, since the total costs would be averaged over fewer bed days.

Thus, the requirement exists for the determination of an average cost for treating a patient with a given standard condition at a particular facility. In order to calculate such a cost, it is first necessary to classify patients into groups within which the resource utilization pattern will fall into a predictable range. The Diagnosis Related Groups (DRGs) recently incorporated by the Health Care Financing Administration (HCFA) into their Prospective Payment System (PPS) appear to offer this possibility. Under this system, patients are placed into one of 470 Diagnosis-Related Groups, or DRGs, based on their diagnoses and the treatments received. Since the generalized implementation of PPS for all Medicare patients, DRGs (especially their fiscal ramifications) have become subjects of intense interest for the many civilian hospitals which treat Medicare patients.

Certain federal agencies have also begun looking seriously at the use of DRGs. In 1980, a report appeared in Modern Healthcare concerning an attempt by the Public Health Service to apply the DRG concept in the management in its eight hospitals--not for reimbursement purposes, but for use as a tool in the management of staffing, bed capacity, length of stay, and various quality of care issues.(2) The closely related Indian Health Service also examined the possible application of DRGs to the management of its own hospital system, but found it unsuitable for its needs.(3)

The Veterans Administration has already incorporated DRGs into its budgeting process. Standard "workload units" for each DRG are multiplied by the respective discharges at each facility, and the products included in the budget calculations for the coming fiscal year. In fiscal year 1985, 40 percent of the total funding was determined to be "at risk" (or sensitive to the DRG mix treated), with a maximum allowable positive or negative impact of 1 percent. For fiscal year 1986, the "amount at risk" will be increased to between 55 and 60 percent of the total funding, and the maximum allowable impact to 3 percent. The objective of the VA is to eventually place all of the funding for each facility "at risk," in order to foster maximum efficiency in the utilization of available resources.(4)

DRG classifications could be of great interest to military facilities, too. Among other things, the degree of standardization made possible by DRGs presents military health care managers and planners with a means of analyzing and describing resource consumption in terms of products and product lines. This makes a multitude of meaningful management and resource allocation decisions possible, including such things as the identification of efficient or inefficient services and comparisons among

similar services or facilities. The information required to analyze costs in this manner at military medical treatment facilites is already available. The patient data presently recorded in the Inpatient Accounting System (IAS), after relatively minor manipulation of the diagnosis and procedure codes, would readily support the assignment of patients into DRGs. Once this were accomplished and all DRGs aligned within their respective UCA cost centers, costs per DRG could be readily calculated using total cost information already provided by the UCA.

One remaining problem is that the systems for tracking costs (UCA) and patient-related information (IAS) operate side-by-side, but cannot communicate with one another. Upon admission, the patient is assigned a UCA cost code at the same time the IAS file is initiated; thereafter the information collected by the two systems never comes together again. Workload data concerning the patient is gathered by the UCA in aggregate form by cost centers; all identification of individual patients is lost. The IAS records statistical data, including the diagnoses and procedures associated with the hospitalization, in individual patient files, but does not concern itself with cost or workload issues. Thus, a bridge must be established between the two systems in order to enable their respective information to be combined in the manner required. One of the purposes of this study will be to create such a bridge and test its practicality.

Statement of the Problem

To develop a methodology to enable direct cost UCA data to be expressed in terms of cost per disposition for specific diagnosis-related groups.

Objectives

The objectives of this study were as follows:

a. Collect both UCA and selected IPDS information for every patient present in or admitted to Martin Army Community Hospital (MACH) during the first three months of fiscal year 1985, and assign a DRG to all patients discharged during the same period

b. Determine for each UCA cost center the DRGs treated during the study period and the number of patients included within each DRG

c. Calculate the average cost per DRG treated within four selected UCA cost centers (Orthopedics, Family Practice Orthopedics, Obstetrics, and Family Practice Obstetrics) during the three-month study period, using direct cost information provided by the UCA, the DRG mix for each cost center, and the 1985 HCFA weights

d. Compare the costs per DRG calculated using this methodology with others based on the average length of stay per DRG and the UCA-generated average cost per occupied bed day for the services examined, as well as with current DRG reimbursement figures obtained from civilian sources

e. Match the UCA codes assigned to each patient against the clinic services recorded in the IAS in order to determine how closely they correspond to one another, and hence whether the IPDS clinic service could be used to identify the UCA code to which patients are assigned.

The final product will be the development of a workable method of estimating the direct cost of treating specific DRGs, given the data provided by the IAS and the UCA, and the identification of recommended modifications to the UCA or IAS which will enhance DRG-related cost identification.

Criteria

The methodology for the identification and calculation of costs per DRG will need to include the following features:

a. No disruption of existing IAS and UCA functions as defined by appropriate regulations

b. Minimized additional manual data manipulation

c. No requirement for additional personnel resources

d. Minimum modifications to the present UCA and IAS systems

In addition, for any statistical tests alpha will be set at 0.05.

Assumptions and Limitations

In general, any assumptions made were linked with certain limitations imposed by the nature of the study, the capabilities of the author, and the facility or its supporting systems, so they will be treated together here. To begin with, it was assumed that both the patient mix and the costs recorded by the UCA during the study period were representative of those which would be encountered at any other period of time during the year. No provisions were made, nor were any found to be practically possible, to determine whether any patients changed from one UCA cost center to another during the course of their hospitalizations, or to divide the cost of their treatment among two or more cost centers if they did. Therefore, it was assumed that each patient remained in the cost center recorded upon admission for the entire hospital stay. Finally, the 1985 HCFA weights used in the calculation process were assumed at the outset to be proportionally representative of the resource consumption within each DRG, barring the discovery of any glaring, immediately obvious exceptions. The aggregative

nature of the data available from the UCA precludes the ready identification of actual costs on a per-patient or per-DRG basis. Therefore, any comparisons made between variously derived costs per DRG can only be used for discussion purposes and the identification of areas for further investigation, rather than for "validation" of any calculated costs. The purpose of the study was not to test the validity of the values of the weights as such, but to develop and test a methodology for their application in a military health care setting.

Review of the Literature

In recent years, interest in potential applications for DRGs has been growing within the Department of Defense. Turner(5) wrote a paper for the Professional Military Comptrollers Course in 1984 which discussed the inadequacies of the medical care composite unit (MCCU) as a measure of resource consumption (and requirements), and recommended that a system based in some way upon DRGs be utilized instead. The Health Care Studies and Clinical Investigations Activity (HCSCIA) was established in early 1984 at Fort Sam Houston, Texas, with the mission of evaluating current workload measurement units for US Army fixed medical treatment facilities (MTFs) and creating new ones more applicable to the present and anticipated information needs of the Army Medical Department. Among other things, the HCSCIA is examining DRGs for possible application in this context.(6) It is anticipated that findings for the inpatient arena will be released near the end of fiscal year 1985.(7)

Vector Research, Incorporated contracted with the Office of the Assistant Secretary of Defense (Health Affairs) to develop means for the "Military Health Service System" (all DOD fixed MTFs) to utilize data

provided by the UCA and USM (Uniform Staffing Methodologies) systems to "provide military medical care planners and analysts with management tools to monitor, assess, and program their facilities."(8) One of the products of their study was a draft handbook which, among other things, contains a methodology and sample worksheet for the calculation of costs per DRG using locally assessed, facility-specific expense factors and the Medicare DRG weights, in order to arrive at an estimated "value" for the health care provided. The facility-specific "reimbursement equivalents" which will be discussed later were calculated for each DRG following essentially this methodology.

Two related projects were reported from Wilford Hall Air Force Medical Center (WHMC) during 1984. Haddock(9), in a Graduate Research Project compared costs per DRG calculated from UCA data at WHMC for 1982 to equivalent HCFA reimbursements for the same period. He found some correlation between the two, but pointed out that much unexplained variation remained to be accounted for. Optenberg et al.(10) examined the same data to determine the relationship, if any, between UCA-measured inpatient service costs and case-complexity. They found no correlation between case-complexity and the average cost per occupied bed day; however, they did find a strong positive correlation between case-complexity and the average cost per disposition.

Rieder and Kay(11) compared DRGs to four other common classification methods used by the U.S. Navy, in terms of their ability to account for variation in length of stay. They reported that DRGs explained significantly more of the variation in length of stay for patients at Naval hospitals than the other techniques. However, the amount of variation accounted for was found to be only about 25 percent, rather than the 43

percent reported in the civilian community.(12) They also reported that approximately 41 percent of the variation in length of convalescent leave was also linked to the DRGs in which the patients fell. Finally, they suggested a number of other variables which might be examined in future studies, including patient transfer status, number of diagnoses, number of surgeries, teaching hospital status, and whether or not the patient was active-duty enlisted.

To date, no report has been published concerning any attempt to apportion total UCA costs for particular inpatient services among their constituent DRGs by means of the HCFA weights or any other weighting system. This project appears to be breaking new ground in this respect.

Methodology

Patient data collection and analysis

During the first quarter of fiscal year 1985, impressions were obtained of the UCA charge plates prepared by Admissions and Dispositions (A&D) clerks for every patient admitted to the hospital from 1 October through 31 December 1984, plus any admitted previously who were still in the hospital on 1 October. Following correction and verification of the data against daily admissions reports, a cross-reference file was constructed which contained each patient's register number, date of admission, and UCA code. A second file was prepared by extracting selected information from the semimonthly reports submitted to the Patient Administration Systems and Biostatistics Activity (PASBA) at Fort Sam Houston, containing the following items of information for each patient discharged during the same period: register number, SSAN, age, sex, discharge diagnosis, dates of admission and discharge, and bed days.

At Fort Sam Houston, the sample records were recoded from ICD-9 to ICD-9-CM diagnosis and procedure codes using a locally developed conversion program, and then run through a Health Systems International DRG Grouper (1983 edition) to asign them to DRGs. The list sent back to Martin Army Hospital included the following information: patient register number, DRG, clinic service, beneficiary code, SSAN, and bed days. Patient records (fortunately few in number) which were unable to be assigned to a working DRG because of incomplete information or a faulty conversion between the two ICD codes were manually recoded and assigned to a DRG using a Data General grouping system at a local civilian hospital.

All patients were matched with their appropriate UCA cost center. Those which fell into the four clinic services addressed during the study were sorted by UCA cost centers and DRGs, and a listing of the patients falling within each of the selected cost centers was obtained.

Cost Calculations

From the UCA Medical Expense Performance Report (MEPR) for the first quarter of fiscal year 1985, total costs were identified for the four selected UCA cost centers. In order to make them comparable to the costs applied to Medicare reimbursements, certain support costs, including EAYA (inpatient depreciation), ECAA (fire protection), EDEA (other engineer support), EDCA (maintenance of real property), EDDA (minor construction), and EBYK (other BASEOPS functions), were subtracted from the MEPR figures for each of the four cost centers. Clinician salaries were also subtracted, since the present Medicare DRGs do not include physician reimbursements. These adjusted direct costs (ADCs) became the starting points for the cost

calculations. A summary of the development of the adjusted direct costs for both major services addressed in the study appears at Appendix A.

The cost per DRG for the patient mix within each cost center was calculated by first computing a weighted case mix (WCM) for each cost center. The quantity of patients falling within each DRG was multiplied by the respective 1985 HCFA weight, after which the products were added together:

$$[n(1,1) \times wt(1,1)] + \ldots + [n(i,1) \times wt(i,1)] = WCM(1).$$

The adjusted direct cost for each cost center was then divided by its respective weighted case mix, in order to obtain a weighted average cost (WAC):

$$ADC(1) \; / \; WCM(1) = WAC(1).$$

This weighted average cost was multiplied by the HCFA weight for each DRG to obtain the average cost per DRG within that cost center:

$$WAC(1) \times wt(1,1) = Cost/DRG(1,1)$$

This methodology was tested against two imaginary facilities, each of which had 100 patients who fell into four different DRGs. The weights of the four DRGs were 0.45, 0.90, 1.35, and 1.80. The first hospital had 40 patients in DRG A, with 30, 20, and 10 patients in DRGs B through D, respectively. The second hospital had the opposite patient mix, with the largest number of patients in DRG D and the smallest in DRG A. To provide a

basis for comparison, a reference rate of $2,000 was used to calculate a standard cost per DRG.

DRG	Weight	Ref Rate	Cost/DRG
A	0.45	$2,000	$900
B	0.90		$1,800
C	1.35		$2,700
D	1.80		$3,600

Based on the cost per DRG and the DRG mix at each hospital, a total hospital cost (corresponding to the adjusted direct UCA cost) was calculated for each facility, as follows:

DRG	Hosp I Qty	Hosp I Costs	Hosp II Qty	Hosp II Costs
A	40	$36,000	10	$9,000
B	30	54,000	20	36,000
C	20	54,000	30	81,000
D	10	36,000	40	144,000
TTL	100	$180,000	100	$270,000

Costs per DRG were then calculated following the methodology detailed above. The weights of the several DRGs were multiplied by their respective patient numbers, and the products added to obtain a weighted average cost for each facility. This was then divided into each facility's total hospital cost, and the result multiplied by the weight of each DRG.

Hospital I:

DRG	Weight	Quantity	Wgtd Qty	Cost/DRG	Ttl/DRG
A	0.45	40	18.00	$900	$36,000
B	0.90	30	27.00	1,800	54,000
C	1.35	20	27.00	2,700	54,000
D	1.80	10	18.00	3,600	36,000
Totals		100	90.00		$180,000
Weighted average cost:				$2,000	

Hospital II:

DRG	Weight	Quantity	Wgtd Qty	Cost/DRG	Ttl/DRG
A	0.45	10	4.50	$900	$9,000
B	0.90	20	18.00	1,800	36,000
C	1.35	30	40.50	2,700	81,000
D	1.80	40	72.00	3,600	144,000
Totals		100	135.00		$270,000

Weighted average cost: $2,000

The costs per DRG came out the same in both sets of calculations, despite the differing patient mix, case-intensity, and total expenses at each facility. As a final test, the total costs and patient loads for the two hospitals were merged and the same calculation process followed again.

DRG	Weight	Quantity	Wgtd Qty	Cost/DRG	Ttl/DRG Hosp I	Ttl/DRG Hosp II
A	0.45	50	22.50	$900	$36,000	$9,000
B	0.90	50	45.00	1,800	54,000	36,000
C	1.35	50	67.50	2,700	54,000	81,000
D	1.80	50	90.00	3,600	36,000	144,000
		200	225.00		$180,000	$270,000

Combined weighted average cost $2,000

Thus, it appears that the proposed methodology should yield valid results regardless of the case-mix, numbers of patients, or total expenses at any given facility, as long as the information used in performing the calculations remains accurate.

Cost comparisons

Four alternate sets of costs per DRG were calculated for each cost center examined, using varying methodologies. The first set applied the

same HCFA weights against a facility-specific rate derived for MACH according to published HCFA guidelines.(13) The "prices" thus calculated equate as closely as possible to the reimbursements MACH would receive for treating Medicare patients in the same DRGs during fiscal year 1985. The second set is an average of the HCFA reimbursement rates for each DRG at two local civilian hospitals. The third set is based on the average cost per occupied bed day for each service, multiplied by the arithmetic mean length of stay (LOS) for each DRG. The final set uses similar calculations, but based on the geometric mean. The percent of variation in the cost per DRG between the original set of costs and those obtained by each of the alternate methodologies was then calculated, along with the variance for each set of comparisons.

IPDS-UCA mapping

Current guidelines at MACH specify to which UCA cost center patients within each IPDS clinical service should be assigned under any given circumstances. This corresponds in most cases to a one-to-one matching of IPDS and UCA clinic services. In order to see how well this actually works, the percentage of patients actually assigned to the predicted cost centers was determined and, by treating the sample as a binomial population, with successes defined as assignments to the predicted cost centers and failures assignments anywhere else, a confidence interval was established for the degree of matching of IPDS and UCA clinic services at MACH.

FOOTNOTES

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II. DISCUSSION

General

Martin Army Community Hospital is a general hospital supporting Fort Benning and a health service area consisting of 80 counties located in east-central Alabama, north-central Florida, and southwestern Georgia.(1) In all, some 92,000 beneficiaries reside in its catchment area. Built on a 500-bed chassis, MACH has 347 beds set up and in place, of which it is staffed to operate 230 at the present time. The average daily patient census varies between 170 and 190. During fiscal year 1984, MACH admitted 10,777 patients to the hospital, assisted with 1,285 births, and accumulated a total of 63,622 occupied bed days. On the outpatient side, there were 694,647 clinic visits during the year, for an average of 1,898 visits daily. The total operating expenses, includng military salaries, recorded by the UCA in FY 1984 amounted to almost $45.8 million. The MACH Operations and Maintenance, Army (OMA) budget, out of which such things as supplies, items of equipment costing less than $3,000, and civilian salaries are funded, totaled just over $26 million in 1984.

The Uniform Chart of Accounts, in order to record and track the utilization of these funds, divides the overall resource consumption of the hospital into six general areas. They are:

A. Inpatient Care

B. Ambulatory Care

C. Dental Care

D. Ancillary Services

E. Support Services

F. Special Programs

The classifications of Inpatient Care, Ambulatory Care, and Dental Care are self-explanatory. The "final operating accounts" within these three areas are the cost centers to which all hospital-related expenses supporting the direct provision of patient care are eventually assigned. Ancillary Services, including such areas as radiology, pharmacy, laboratory, and rehabilitative services, provide specific services in support of patient care, but generally do not bear final responsibility for diagnosis or the overall coordination of the patient's treatment regimen. All accounts within this designation are "intermediate operating accounts," which means that all of their expenses are eventually reassigned to final operating accounts. Support Services perform management and administrative functions ranging from command or personnel support services to hospital food service. Under this classification are also found accounts for depreciation, building and grounds maintenance, and other overhead costs. All Support Services accounts are also intermediate operating accounts. The last general classification, Special Programs, summarizes expenses incurred by the MTF, generally in connection with military-specific programs, which are final consumers of resources but do not involve the direct provision of patient care. Included here are such activities as public health services, patient movement, and military patient administration. All subaccounts within this group are final operating accounts.

The second level of UCA account classification consists of the major summary accounts that fall within each of the six general areas. At Martin Army Community Hospital the inpatient summary accounts, along with their respective shares of the FY 1983 total inpatient workload for the facility as a whole, are as follows:

AA.	Medicine	40.8%
AB.	Surgery	13.7%
AC.	Obstetrics/Gynecology	21.9%
AD.	Pediatrics	14.2%
AE.	Orthopedics	7.9%
AF.	Psychiatry	1.6%

The UCA account classification process continues for two more levels. The third level depicts individual services or cost centers within each summary account. The overall field of OB/GYN, for example, is divided into ACA (Gynecology) and ACB (Obstetrics). Within Orthopedics, there are AEA (Orthopedics) and AEB (Podiatry). These codes are standardized among all Army MTFs. The final, or fourth level is facility-specific, and is used for any further differentiation necessary. At MACH, an "F" is placed in the fourth position for patients admitted within a given service whose primary physician is a family practitioner; otherwise an "A" is placed there. Thus, ACBA indicates regular Obstetrics, ACBF Family Practice Obstetrics, AEAA Regular Orthopedics, and AEAF Family Practice Orthopedics.

The overall methodology followed by the UCA in its cost assignment process involves five sequential steps: First, non-personnel expenses and performance data are collected and compiled for each UCA expense account used at the facility. Second, personnel full-time equivalent (FTE) man-months and salary expenses are distributed among the UCA accounts. Third, any transfers of expenses between accounts which do not require the inclusion of overhead costs are accomplished. Fourth, expenses generated by intermediate operating expense accounts are assigned through a sequential allocation process to final operating accounts and cost pools made up of

final operating accounts. Finally, expenses assigned to cost pools are distributed among their constituent final operating accounts.(2)

In choosing the services from which the patient samples for the study were to be drawn, several factors were considered. It was desired to have at least one service with a relatively narrow range of DRGs and another with a broader range, in order to test the methodology under both conditions. It was also considered desirable to select services whose patients would generally not require intensive care, which is a separate final operating account under the UCA and hence rather difficult to work into the calculations. Therefore, Obstetrics and Orthopedics were chosen. A further advantage with these two services is that both also have family practice cost centers, which would facilitate the evaluation of the mechanisms for capturing costs and workload at the service and sub-service level, as well as comparing the DRG mix between the regular and Family Practice services.

During the study period, admission-related information was collected for a total of 2,786 patients, and discharge-related information for 2,695 patients. The UCA reported a total of 2,688 dispositions for the same time period. A total of 736 patients comprised the study sample--204 in Orthopedics, 470 in Obstetrics, and 52 in Family Practice Obstetrics. There were only three patients recorded in Family Practice Orthopedics during the quarter and virtually no costs assigned, so they were simply merged with the regular Orthopedics patients for the remainder of the study.

Analysis: Obstetrics

Within the overall area of Obstetrics, the UCA recorded 525 dispositions. The IPDs data from which the study sample was taken included 522 patients within either regular or Family Practice Obstetrics, a

difference of less than one percent from the UCA total. This variance was not considered to be significant. The regular OB patients fell into a total of 14 DRGs, with the following distribution:

DRG	Description	Qty	Prcnt
373	Vaginal delivery w/o complicating diagnoses	221	47.0
467	Other factors influencing health status	101	21.5
371	Caesarean section w/o complicating conditions	29	6.2
383	Other antepartum diagnoses with medical complications	27	5.7
379	Threatened abortion	27	5.7
372	Vaginal delivery w/complications	17	3.6
370	Caesarean section w/ complicating conditions	15	3.2
384	Other antepartum diagnoses w/o medical complications	12	2.6
374	Vaginal delivery w/ sterilization and/or D&C	11	2.3
381	Abortion w/ D&C	6	1.3
	All others (includes patients in 4 other DRGs)	4	0.9
Total		470	

The Family Practice OB patients fell into 10 DRGs as follows:

DRG	Description	Qty	Prcnt
373	Vaginal delivery w/o complicating diagnoses	28	53.8
467	Other factors influencing health status	6	11.5
370	Caesarean section w/ complicating conditions	3	5.8
371	Caesarean section w/o complicating conditions	3	5.8
372	Vaginal delivery w/o complicating diagnoses	3	5.8
374	Vaginal delivery w/ sterilization and/or D&C	3	5.8
379	Threatened abortion	3	5.8
	All others (includes 3 other DRGs)	3	5.8
Totals		52	

Not surprisingly, there was a high amount of overlap between the DRGs treated within the two services. Virtually all of the DRGs treated by family practitioners were also treated by regular obstetricians; however, two DRGs--383 and 384--were treated under regular Obstetrics but not under Family Practice. Both of these DRGs include patients with difficult pregnancies--DRG 383 because of accompanying medical problems such as diabetes, hypertension, and urinary tract infections, and DRG 384 because of

prematurity--and it would be logical to expect that such patients would be cared for by obstetricians, rather than by family practitioners. All patients in DRG 384 were evacuated to other facilities within one day of admission, since MACH has no facilities to treat premature infants. The weight of 0.3211 assigned to DRG 384, commensurate with the HCFA average LOS of 2.2 days, is low enough that it is still probably reasonably appropriate, even considering the shorter length of stay at MACH.

DRG 467, "Other factors influencing health status," presents another picture altogether. All patients in this group were admitted to the hospital for a "non-stress test"--a relatively minor procedure conducted in the Labor and Delivery suite which usually takes up to two hours. In effect, patients are admitted to the hospital for what could probably be considered to be an outpatient procedure. There are a number of reasons for this. First there are medical considerations, since the women involved are either very close to their due dates, bearing high-risk babies, or both. Thus it would be a wise precaution to admit them to the hospital and have the full staff available should any problems arise or labor begin. There is a fiscal consideration too, since a 30 to 1 differential exists between the MCCUs awarded for an admission and those for a regular clinic visit. The author is not in a position to judge the justifiability of this practice, but the fact that it occurs causes distortion in the calculated costs unless adjustments are made, since the published HCFA weight for DRG 467 is 0.9697--over twice that for a normal vaginal delivery!

Length of stay data for the two services appears in Table 1. The "average LOS" is the arithmetic mean length of stay within each DRG.

Obstetrics

DRG	Qty	Prcnt	Weight	Avg LOS	Out-liers	New LOS	Geom LOS	HCFA LOS
373	221	47.0	0.4021	2.96	1	2.96	2.85	3.20
467	101	21.5	0.0667	1.00		1.00	1.00	6.10
371	29	6.2	0.7457	5.52	1	5.11	5.28	6.10
383	27	5.7	0.4272	3.63		3.63	2.73	3.40
379	27	5.7	0.3136	1.26		1.26	1.18	2.20
372	17	3.6	0.5476	8.77	1	8.06	7.56	3.80
370	15	3.2	0.9809	6.20		6.20	6.02	7.60
384	12	2.6	0.3211	1.00		1.00	1.00	2.20
374	11	2.3	0.5435	3.45		3.45	3.40	3.60
381	6	1.3	0.3565	1.50		1.50	1.35	1.40
069	1	0.2	0.5361	2.00		2.00	2.00	4.80
368	1	0.2	0.7861	4.00		4.00	4.00	6.70
380	1	0.2	0.2677	2.00		2.00	2.00	1.50
450	1	0.2	0.5895	1.00		1.00	1.00	3.90
Total	470							

Family Practice Obstetrics

DRG	Qty	Prcnt	Weight	Avg LOS	Geom LOS	HCFA LOS
373	28	53.8	0.4021	2.68	2.51	3.20
467	6	11.5	0.9697	1.00	1.00	6.10
370	3	5.8	0.9809	6.33	6.21	7.60
371	3	5.8	0.7457	4.67	4.64	6.10
372	3	5.8	0.5476	3.67	3.56	3.80
374	3	5.8	0.5435	3.00	2.88	3.60
379	3	5.8	0.3136	1.33	1.26	2.20
183	1	1.9	0.5593	2.00	2.00	4.80
381	1	1.9	0.3565	2.00	2.00	1.40
383	1	1.9	0.4272	1.00	1.00	3.40
Total	52					

Table 1: Length of stay comparisons - Obstetrics services, 1985

"Outliers" are patients whose LOS equaled or exceeded the figure specified by HCFA for that particular DRG. The "new LOS" is the recomputed mean after the deletion of any outliers. The "geometric LOS" is the geometric mean,

calculated by taking the nth root of the product of all of the individual LOS within each DRG, in this case without subtracting any outliers beforehand. The "HCFA LOS," also a geometric mean, is a national average published by HCFA for each DRG. Of the three means computed from the sample data, the geometric mean was the most successful in minimizing the effect of extreme values. Within both Obstetrics and Family Practice Obstetrics during the study period, the geometric mean was an average of 20 to 25 percent lower than the HCFA LOS in nearly every case. One notable exception was DRG 372, which for regular Obstetrics had an average (geometric) length of stay of 7.56 days--nearly twice the published HCFA average of 3.8 days. Interestingly, Family Practice had an average LOS of 3.56 days for the same DRG, well below the HCFA average. No ready explanation was found for this difference between the patients in the two services. Since DRG 372 includes vaginal deliveries with complications, the increased LOS could be a function of the severity of the patients' conditions, current practices at MACH, or both.

Tables 2 and 3 (Table 2 for Obstetrics and Table 3 for Family Practice) show the costs per DRG calculated following the methodology described earlier, along with two sets of alternative costs for comparison purposes. The weighted cost ("wgtd cost" in the figures) is the originally calculated cost per DRG. The "HCFA cost" figures are equivalent to the Medicare reimbursements that would apply to each DRG were MACH a civilian facility. They were obtained by the multiplication of each DRG weight by a facility-specific standard rate. The calculation, following published HCFA guidelines, of this standard rate for MACH is summarized in Appendix B. The civilian reimbursement ("civ reimb") is an average of the current HCFA reimbursements for each DRG at two local civilian hospitals. The last

Original HCFA weights

DRG	Qty	Weight	Wgtd Cost	HCFA Cost	Civ Reimb	Wgtd Total	UCA Total	Civ Reimb Total
373	221	0.4021	$588	$1,057	$1,005	$129,848	$233,591	$222,122
467	101	0.9697	1,417	2,549	2,424	143,109	257,448	244,815
371	29	0.7457	1,090	1,960	1,864	31,599	56,845	54,054
383	27	0.4272	624	1,123	1,068	16,854	30,320	28,832
379	27	0.3136	458	824	784	12,372	22,257	21,165
372	17	0.5476	800	1,439	1,369	13,603	24,470	23,271
370	15	0.9809	1,433	2,578	2,452	21,499	38,676	36,778
384	12	0.3211	469	844	803	5,630	10,129	9,632
374	11	0.5435	794	1,429	1,359	8,736	15,715	14,944
381	6	0.3565	521	937	891	3,125	5,623	5,346
069	1	0.5361	783	1,409	1,340	783	1,409	1,340
368	1	0.7861	1,149	2,066	1,965	1,149	2,066	1,965
380	1	0.2677	391	704	669	391	704	669
450	1	0.5895	861	1,550	1,474	861	1,550	1,474
TTL	470					$389,560	$700,803	$666,407

Weighted Avg Cost $1,461
Computed HCFA rate $2,629

After modification of weight for DRG 467

DRG	Qty	Weight	Wgtd Cost	HCFA Cost	Civ Reimb	Wgtd Total	HCFA Total	Civ Reimb Total
373	221	0.4021	$890	$1,057	$1,005	$196,708	$233,591	$222,122
467	101	0.0725	160	191	181	16,209	19,248	18,304
371	29	0.7457	1,651	1,960	1,864	47,869	56,845	54,054
383	27	0.4272	946	1,123	1,068	25,532	30,320	28,832
379	27	0.3136	694	824	784	18,743	22,257	21,165
372	17	0.5476	1,212	1,439	1,369	20,607	24,470	23,271
370	15	0.9809	2,171	2,578	2,452	32,570	38,676	36,778
384	12	0.3211	711	844	803	8,529	10,129	9,632
374	11	0.5435	1,203	1,429	1,359	13,234	15,715	14,944
381	6	0.3565	789	937	891	4,735	5,623	5,346
069	1	0.5361	1,187	1,409	1,340	1,187	1,409	1,340
368	1	0.7861	1,740	2,066	1,965	1,740	2,066	1,965
380	1	0.2677	593	704	669	593	704	669
450	1	0.5895	1,305	1,550	1,474	1,305	1,550	1,474
TTL	470					$389,560	$462,603	$439,895

Revised wgtd avg cost $2,214

Table 2: Cost/DRG Calculations - ACBA (Obstetrics), 1985

Original HCFA weights

DRG	Qty	Weight	Wgtd Cost	HCFA Cost	Civ Reimb	Wgtd Total	HCFA Total	Civ Reimb Total
373	28	0.4021	$702	$1,057	$1,005	$19,662	$29,599	$28,140
467	6	0.9697	1,693	2,549	2,424	$10,161	15,296	14,544
370	3	0.9809	1,713	2,579	2,452	$5,139	7,736	7,356
371	3	0.7457	1,302	1,960	1,864	$3,907	5,881	5,592
372	3	0.5476	956	1,440	1,369	$2,869	4,319	4,107
374	3	0.5435	949	1,429	1,359	$2,847	4,287	4,077
379	3	0.3136	548	824	784	$1,643	2,473	2,352
183	1	0.5593	977	1,470	1,398	$977	1,470	1,398
381	1	0.3565	623	937	891	$623	937	891
383	1	0.4272	746	1,123	1,068	$746	1,123	1,068
TTL	52					$48,573	$73,123	$69,525

Weighted average cost $1,746
Facility HCFA Rate $2,629

After modification of weight for DRG 467

DRG	Qty	Weight	Wgtd Cost	HCFA Cost	Civ Reimb	Wgtd Total	HCFA Total	Civ Reimb Total
373	28	0.4021	$871	$1,057	$1,005	$24,381	$29,599	$28,140
467	6	0.0725	157	191	2,424	$942	1,144	14,544
370	3	0.9809	2,124	2,579	2,452	$6,372	7,736	7,356
371	3	0.7457	1,615	1,960	1,864	$4,844	5,881	5,592
372	3	0.5476	1,186	1,440	1,369	$3,557	4,319	4,107
374	3	0.5435	1,177	1,429	1,359	$3,531	4,287	4,077
379	3	0.3136	679	824	784	$2,037	2,473	2,352
183	1	0.5593	1,211	1,470	1,398	$1,211	1,470	1,398
381	1	0.3565	772	937	891	$772	937	891
383	1	0.4272	925	1,123	1,068	$925	1,123	1,068
TTL	52					$48,573	$58,970	$69,525

Modified wgtd avg cost $2,165

Table 3: Cost/DRG Calculations - ACBF (Family Practice Obstetrics), 1985

three columns are total dollar amounts per DRG for each of three cost figures, obtained by multiplying the applicable cost or reimbursement figure by the total number of patients within each DRG.

The upper halves of each table show costs based on the original HCFA weights. The lower tables show the same costs calculated after changing the weight of DRG 467 from 0.9697 to 0.0725 to bring the calculated cost more in line with the estimated cost of what actually took place. With the large number of patients in this DRG, particularly in regular Obstetrics, this revision has a dramatic effect on the calculation of the costs for the remaining DRGs, which were artificially depressed in the first sets of calculations. The more accurately estimated costs per DRG from the lower tables will be used in any future discussion. For comparison purposes, the civilian reimbursement for DRG 467 was also recomputed to $181, based on the revised weight of 0.0725 and a standard rate of $2,500 obtained by dividing the other average civilian reimbursements by their respective DRG weights.

The lowest costs per DRG for both services were those calculated using the original methodology (UCA-HCFA weights). The average civilian reimbursements per DRG were 12.6 percent higher, while the facility reimbursement equivalents derived from the constructed HCFA facility rate were 18.4 percent higher than the original weighted costs. When the calculated costs per DRG were compared between the two services, those in regular Obstetrics were an average of 0.3 percent higher per DRG than those in Family Practice. This small differential probably reflects the assignment of one or two patients to an incorrect UCA service. There were in fact a number of patients in the study sample with inconsistencies between their UCA and IPDS clinical services, and it is possible that a few

assignment errors might have crept in during the reconciliation process. It speaks well for the accuracy of the data collection process that the cost figures for the two services came out as close as they did.

Tables 4 and 5 depict comparisons between the weighted DRG cost and those derived from average length of stay data. In the upper half of each, the arithmetic mean LOS for each DRG has been multiplied by its respective number of patients, and the sum of the resultant products (an estimate of the total patient days) divided into the adjusted total UCA costs to give an average cost per occupied bed day. This was then multiplied by the applicable average LOS to give an average cost per DRG. The second table shows a similar calculation procedure using the geometric LOS instead. The costs calculated using the different LOS figures do not vary markedly from one another in either service--a reflection of the nearness of the various means. For the purpose of these calculations, the LOS for DRG 467 was reduced from the 1 day recorded in the IPDS to 0.5 days. This gives a more realistic cost for this DRG, while reducing at the same time the probable error in the calculation of the other costs. The comparison between the LOS-based costs and those calculated for each DRG using the HCFA weights gives an approximate idea of the relative impact the LOS has on the total cost, as well as of how close the LOS-based figure comes to that calculated from the HCFA weights. In the case of regular Obstetrics, both sets of LOS-derived costs average approximately 15 percent below the weighted costs per DRG, although the spread for the geometric LOS costs is less (-55 percent to +98 percent) than that for the arithmetic mean LOS (-58 percent to +116 percent). Family Practice also had less variability between the

Cost comparisons based on average LOS.

DRG	Qty	Weight	Wgtd Cost	Avg LOS	ALOS Cost	Dffrnc	Ttl Wgtd Costs	Ttl LOS Costs
373	221	0.4021	$890	2.96	$882	-0.87%	$196,708	$195,005
467	101	0.0725	160	0.50	149	-7.13%	16,209	15,054
371	29	0.7457	1,651	5.52	1,646	-0.31%	47,869	47,720
383	27	0.4272	946	3.63	1,082	14.43%	25,532	29,217
379	27	0.3136	694	1.26	376	-45.89%	18,743	10,141
372	17	0.5476	1,212	8.77	2,614	115.68%	20,607	44,444
370	15	0.9809	2,171	6.20	1,848	-14.88%	32,570	27,723
384	12	0.3211	711	1.00	298	-58.06%	8,529	3,577
374	11	0.5435	1,203	3.45	1,028	-14.52%	13,234	11,313
381	6	0.3565	789	1.50	447	-43.34%	4,735	2,683
069	1	0.5361	1,187	2.00	596	-49.76%	1,187	596
368	1	0.7861	1,740	4.00	1,192	-31.48%	1,740	1,192
380	1	0.2677	593	2.00	596	0.61%	593	596
450	1	0.5895	1,305	1.00	298	-77.16%	1,305	298
TTL	470		Average difference			-15.19%	$389,560	$389,560

Weighted average Cost $2,214
UCA average daily cost $298

Cost comparisons based on geometric mean LOS

DRG	Qty	Weight	Wgtd Cost	Geom LOS	Geom Cost	Diff C	Total /DRG	Geom Total
373	221	0.4021	$890	2.85	$907	1.88%	$196,708	$200,402
467	101	0.0725	160	0.50	159	-0.87%	16,209	16,068
371	29	0.7457	1,651	5.28	1,680	1.77%	47,869	48,719
383	27	0.4272	946	2.73	869	-8.15%	25,532	23,453
379	27	0.3136	694	1.18	375	-45.92%	18,743	10,137
372	17	0.5476	1,212	7.56	2,405	98.44%	20,607	40,892
370	15	0.9809	2,171	6.02	1,915	-11.79%	32,570	28,731
384	12	0.3211	711	1.00	318	-55.24%	8,529	3,818
374	11	0.5435	1,203	3.40	1,082	-10.08%	13,234	11,900
381	6	0.3565	789	1.35	430	-45.57%	4,735	2,577
069	1	0.5361	1,187	2.00	636	-46.38%	1,187	636
368	1	0.7861	1,740	4.00	1,273	-26.86%	1,740	1,273
380	1	0.2677	593	2.00	636	7.39%	593	636
450	1	0.5895	1,305	1.00	318	-75.62%	1,305	318
TTL	470		Average difference			-15.50%	$389,560	$389,560

Average daily cost $318

Table 4: Weighted vs. LOS-derived cost comparisons - Obstetrics, 1985

Cost comparisons based on average LOS

DRG	Qty	Weight	Wgtd Cost	Avg LOS	ALOS Cost	Diffrnc	Wgtd Total	LOS Total
373	28	0.4021	$871	2.68	$930	6.76%	$24,381	$26,028
467	6	0.0725	157	0.50	173	10.46%	942	1,041
370	3	0.9809	2,124	6.33	2,196	3.36%	6,372	6,587
371	3	0.7457	1,615	4.67	1,620	0.31%	4,844	4,859
372	3	0.5476	1,186	3.67	1,273	7.35%	3,557	3,819
374	3	0.5435	1,177	3.00	1,041	-11.59%	3,531	3,122
379	3	0.3136	679	1.33	461	-32.07%	2,037	1,384
183	1	0.5593	1,211	2.00	694	-42.72%	1,211	694
381	1	0.3565	772	2.00	694	-10.14%	772	694
383	1	0.4272	925	1.00	347	-62.51%	925	347
TTL	52	Average difference				-13.08%	$48,573	$48,573

Weighted average cost $2,165
Average daily cost $347

Cost comparisons based on geometric mean LOS

DRG	Qty	Weight	Wgtd Cost	Geom LOS	Geom Cost	Diffrnc	Wgtd Total	Geom Total
373	28	0.4021	$871	2.51	$910	4.55%	$24,381	$25,489
467	6	0.0725	157	0.50	181	15.50%	942	1,088
370	3	0.9809	2,124	6.21	2,252	6.03%	6,372	6,757
371	3	0.7457	1,615	4.64	1,683	4.21%	4,844	5,048
372	3	0.5476	1,186	3.56	1,291	8.88%	3,557	3,873
374	3	0.5435	1,177	2.88	1,045	-11.25%	3,531	3,134
379	3	0.3136	679	1.26	457	-32.71%	2,037	1,371
183	1	0.5593	1,211	2.00	725	-40.11%	1,211	725
381	1	0.3565	772	2.00	725	-6.04%	772	725
383	1	0.4272	925	1.00	363	-60.80%	925	363
TTL	52	Average Difference				-11.17%	$48,573	$48,573

Geometric avg daily cost $363

Table 5: Weighted vs. LOS-derived costs - Fam Pract OB, 1985

geometric LOS-based costs and the weighted costs than between those obtained from the arithmetic mean LOS and the same weighted costs.

Analysis: Orthopedics

The IPDS recorded 204 patient dispositions within Orthopedics during the study period, compared to the 205 recorded by the UCA. As expected, there was a much wider distribution of DRGs in this service, with 38 DRGs represented altogether. The high of 21 patients occurred in DRG 234, while 12 DRGs contained only one patient. The top 20 DRGs were distributed as follows:

DRG	Description	Qty	Prcnt
234	Other musculoskelet sys + conn tiss OR proc, age>69 w/C.C.	21	10.3
222	Knee procedures age<70 w/o C.C. (complicating conds) 19	9.3	
278	Cellulitis age 18-69 w/o C.C.	18	8.8
231	Local excision + removal of int fix devices exc hip, femur	16	7.8
243	Medical back problems	16	7.8
232	Arthroscopy	15	7.4
227	Soft tissue procedures age<70 w/o C.C.	12	5.9
468	Unrelated OR proc to a given major diagnostic category	8	3.9
256	Other diagnoses of musculoskeletal system, conn tiss	6	2.9
281	Trauma to the skin, subcut tiss, breast age 18-69 w/o C.C.	6	2.9
233	Other musculoskelet sys, conn tiss OR proc age>69 +/or C.C	5	2.5
239	Pathological Fx + musculoskeletal + conn tiss malignancy	5	2.5
248	Tendonitis, myositis + bursitis	5	2.5
251	Fx,sprns,strns + Cisl of forearm,hand,foot age 18-69w/o CC	5	2.5
270	Other skin, subcut tiss + breast OR proc age<70 w/o C.C.	5	2.5
217	WND debr + skn grft exc hand,FCR,msclskltl + conn tiss CIS	4	2.0
247	Signs + symptoms of musculoskeletal sys + conn tissue	4	2.0
254	Fx,sprns,str + cisl of uparm,loleg,exc ft age 18-69 w/o CC	4	2.0
224	Upper extremity proc exc humerus + hand age<70 w/o C.C.	3	1.5
253	Fx,sprns,str + cisl of uparm,loleg ex foot age>69 +/or CC	3	1.5
	All others (including 18 DRGs)	24	11.8
Total		204	

Length-of-stay data for Orthopedics is presented in Table 6. The various mean LOS for each DRG are computed in the same manner as those in the two obstetrical services. Significantly, there is a much wider dispersion in the length of stay associated with orthopedic patients,as well as a higher percentage of outliers. Within DRG 234, for example,the LOS ranges from 2 to 165 days, and there were 5 outliers with LOS greater than 29 days. DRG 232 had a slightly tighter LOS distribution (5 to 45 days), but 6 of the 15 patients were outliers. There appears in fact to be a bimodal distribution in this DRG, with 9 patients clustered about a lower mean of 6.9 days, and the 6 outliers about an upper mean of 30 days. Interestingly, all of the patients who became LOS outliers in both DRG 232 and 234 were enlisted soldiers. This was also the case for the other DRGs in this service. Although the statistical significance of this observation is weakened by the small numbers of patients in each DRG, it does suggest that there is something about junior enlisted soldiers which causes them to be kept in the hospital for a longer period of time than other patients. This will be explored in greater detail later.

Because of the high incidence of extreme values and the low number of observations within each DRG, there is a predictably large difference between the average LOS calculated before and after the exclusion of outliers. The geometric mean, even without the exclusion of outliers, eases much of the impact of extreme values upon the mean, especially when the actual number of outliers is low compared to the total number of patients in a particular DRG.

DRG	Qty	Prcnt	HCFA Weight	Avg LOS	Out-liers	Adj LOS	Geom LOS	HCFA LOS
234	21	10.3	1.2325	24.71	5	8.38	11.66	8.20
222	19	9.3	0.9794	13.37	2	9.00	10.09	6.40
278	18	8.8	0.8012	7.56	1	6.29	5.64	7.20
231	16	7.8	0.9420	11.06	2	7.79	7.31	5.30
243	16	7.8	0.7473	11.88	1	8.87	8.70	7.50
232	15	7.4	0.6000	16.47	6	6.89	12.17	3.60
227	12	5.9	0.6271	10.42	2	7.00	7.39	4.20
468	8	3.9	2.0818	43.25	3	12.60	23.18	11.20
256	6	2.9	0.8616	8.67	1	4.20	4.20	6.50
281	6	2.9	0.5321	8.67	2	4.25	5.42	4.20
233	5	2.5	1.7553	30.20	2	18.00	22.48	13.10
239	5	2.5	1.0865	9.40		9.40	7.81	9.20
248	5	2.5	0.6072	8.60		8.60	5.49	5.40
251	5	2.5	0.5902	4.40		4.40	3.73	4.20
270	5	2.5	0.8039	6.20		6.20	4.80	4.50
217	4	2.0	2.2587	30.25	1	10.33	14.11	13.10
247	4	2.0	0.6491	10.50		10.50	6.70	5.80
254	4	2.0	0.6193	8.50		8.50	5.30	5.30
224	3	1.5	0.8859	5.00		5.00	4.93	5.60
253	3	1.5	0.7388	36.33	1	9.50	19.63	6.40
228	2	1.0	0.3588	6.50	1	4.00	6.00	2.20
229	2	1.0	0.5936	6.00		6.00	6.00	3.40
235	2	1.0	1.7403	8.00		8.00	6.93	13.60
236	2	1.0	1.3711	10.00		10.00	9.17	11.90
271	2	1.0	1.3659	13.50		13.50	9.59	12.10
443	2	1.0	1.5053	23.00	1	6.00	15.49	6.60
006	1	0.5	0.3952	5.00		5.00	5.00	2.60
008	1	0.5	0.7164	4.00		4.00	4.00	4.10
019	1	0.5	0.6903	1.00		1.00	1.00	5.70
029	1	0.5	0.7100	1.00		1.00	1.00	3.80
215	1	0.5	1.4765	8.00		8.00	8.00	13.00
219	1	0.5	1.0678	3.00		3.00	3.00	8.30
255	1	0.5	0.4638	5.00		5.00	5.00	2.90
265	1	0.5	1.4804	25.00		25.00	25.00	8.60
277	1	0.5	0.8771	3.00		3.00	3.00	8.30
285	1	0.5	2.8360	51.00	1	51.00	51.00	24.00
440	1	0.5	1.4653	9.00		9.00	9.00	7.20
461	1	0.5	1.6335	6.00		6.00	6.00	8.00
TTL	204							

Table 6: Length of stay comparisons - Orthopedics, 1985

A simple experiment might serve to demonstrate this more clearly. DRG 234 had the following LOS distribution within the study sample:

2,3,4,4,5,5,5,6,7,7,7,12,13,14,20,20,30,44,72,74,165.

The initial arithmetic mean was 24.7 days, and the geometric mean 11.66 days. If the five outliers are removed one by one in a specific order, the following recomputed means result.

a. Beginning with the lowest outlier, and proceeding to the next higher:

Removed	New A mean	New G mean
30	24.45	11.12
44	23.42	10.34
72	20.72	9.29
74	17.58	8.22
165	8.38	6.81

b. Beginning with the highest outlier and moving downward:

Removed	New A mean	New G mean
165	17.70	10.21
74	14.74	9.20
72	11.56	8.21
44	9.65	7.43
30	8.38	6.81

Thus, the geometric mean is not as profoundly affected by the magnitude of extreme values or the order in which they are removed as the arithmetic mean. This becomes important when performing LOS-related calculations upon fairly large amounts of data, for using the geometric mean provides a better starting point for calculations, even without the individual identification and removal of outliers, as long as the assumption remains true that any extreme values encountered are relatively few in number.

The weighted cost calculations shown in Table 7 parallel those discussed earlier for the obstetrical services. No obvious instances

DRG	Qty	Weight	Wgtd Cost	HCFA Cost	Civ Reimb	Ttl Wgtd Costs	Ttl HCFA Costs	Ttl Civ Reimb
234	21	1.2325	$3,625	$3,240	$3,081	$76,124	$68,045	$64,696
222	19	0.9794	2,881	2,575	2,448	54,730	48,922	46,515
278	18	0.8012	2,356	2,106	2,003	42,416	37,914	36,048
231	16	0.9420	2,771	2,477	2,355	44,329	39,624	37,675
243	16	0.7473	2,198	1,965	1,868	35,166	31,434	29,887
232	15	0.6000	1,765	1,577	1,500	26,470	23,661	22,497
227	12	0.6271	1,844	1,649	1,568	22,133	19,784	18,810
468	8	2.0818	6,123	5,473	5,204	48,983	43,784	41,630
256	6	0.8616	2,534	2,265	2,154	15,204	13,591	12,922
281	6	0.5321	1,565	1,399	1,330	9,390	8,393	7,980
233	5	1.7553	5,163	4,615	4,388	25,813	23,073	21,938
239	5	1.0865	3,196	2,856	2,716	15,978	14,282	13,579
248	5	0.6072	1,786	1,596	1,518	8,929	7,982	7,589
251	5	0.5902	1,736	1,552	1,475	8,679	7,758	7,376
270	5	0.8039	2,364	2,113	2,009	11,822	10,567	10,047
217	4	2.2587	6,643	5,938	5,646	26,572	23,752	22,584
247	4	0.6491	1,909	1,706	1,622	7,636	6,826	6,490
254	4	0.6193	1,821	1,628	1,548	7,286	6,513	6,192
224	3	0.8859	2,606	2,329	2,214	7,817	6,987	6,643
253	3	0.7388	2,173	1,942	1,847	6,519	5,827	5,540
228	2	0.3588	1,055	943	897	2,111	1,887	1,794
229	2	0.5936	1,746	1,561	1,484	3,492	3,121	2,967
235	2	1.7403	5,118	4,575	4,350	10,237	9,150	8,700
236	2	1.3711	4,033	3,605	3,427	8,065	7,209	6,854
271	2	1.3659	4,017	3,591	3,414	8,035	7,182	6,828
443	2	1.5053	4,427	3,957	3,763	8,855	7,915	7,525
006	1	0.3952	1,162	1,039	988	1,162	1,039	988
008	1	0.7164	2,107	1,883	1,791	2,107	1,883	1,791
019	1	0.6903	2,030	1,815	1,725	2,030	1,815	1,725
029	1	0.7100	2,088	1,867	1,775	2,088	1,867	1,775
215	1	1.4765	4,343	3,882	3,691	4,343	3,882	3,691
219	1	1.0678	3,141	2,807	2,669	3,141	2,807	2,669
255	1	0.4638	1,364	1,219	1,159	1,364	1,219	1,159
265	1	1.4804	4,354	3,892	3,700	4,354	3,892	3,700
277	1	0.8771	2,580	2,306	2,192	2,580	2,306	2,192
285	1	2.8360	8,341	7,456	7,089	8,341	7,456	7,089
440	1	1.4653	4,310	3,852	3,663	4,310	3,852	3,663
461	1	1.6335	4,804	4,294	4,084	4,804	4,294	4,084
TTL	204					$583,412	$521,498	$495,834

Adj UCA Total Cost	$583,412
Weighted average cost	$2,941
HCFA Facility Cost	$2,629

Table 7: Cost per DRG calculations - Orthopedics, 1985

of inappropriate weighting were found. It is interesting to note that in contrast to Obstetrics where the UCA-derived weighted costs per DRG werealmost 13 percent lower than comparable civilian reimbursements and over 18 percent lower than the computed HCFA equivalent reimbursement, the opposite was true for Orthopedics. The UCA-based weighted cost per DRG came out 11.9 percent higher than the equivalent HCFA reimbursement, and 17.7 percent higher than the average civilian reimbursement for the same DRG. This differential became predictable with the calculation of the weighted average cost of $2,941, compared to the HCFA equivalent rate of $2,629 and the derived civilian standard rate of $2,500. For Obstetrics the same weighted average cost was $2,214; the other two rates, because of their facility-wide applicability, remained the same.

The case mix indices for the two services offer some explanation for the difference in the weighted average costs between the two services. Orthopedics had a case mix index of 0.9723, while the adjusted (DRG 467 excluded) case mix index for Obstetrics was 0.4570. All other things being equal, the service with the higher case mix index would also be expected to have higher costs per disposition, on the average.

The additional effect of extreme variations in the length of stay on the cost per disposition becomes particularly evident when actual (weighted) expenses are compared to both the theoretical facility and the average civilian reimbursements. The average LOS for orthopedic patients at MACH was generally considerably higher than that for the equivalent DRG in a civilian facility. This is probably a reflection of the unique requirements associated with military facilities. Civilian hospitals usually keep their patients in the hospital.only as long as skilled nursing care is required,

after which they are sent home to complete their recovery. Military MTFs, however, cannot do this, at least not with active-duty patients. The services are obligated to ensure that their personnel are properly housed and cared for at all times. Single soldiers in particular can not generally be placed on quarters when they require bed rest; they are put in the hospital instead, even though they might not otherwise be "sick" enough to require hospitalization. A barracks is no place for a bedridden soldier, not only because of his adverse effect on the mission of the unit, but also because of the unit's inability to provide proper assistance to him. Thus, instead of being treated and promptly sent home to complete their recuperation, most active-duty patients (including those in Orthopedics) are kept in the hospital until they are well enough to go on convalescent leave. This naturally drives up the average LOS in the DRGs which include those patients. It is interesting to note again that all LOS "outliers" within Orthopedics during the study period were active-duty enlisted soldiers. Such was not the case with the few Obstetrics outliers, who were sicker patients and therefore "true" outliers.

Tables 8 and 9 show comparisons between the weighted costs per DRG and those obtained from the multiplication of the average cost per occupied bed day for the service as a whole by the average LOS of each individual DRG. Table 8 is based on the arithmetic mean, and Table 9 on the geometric mean (with no outliers excluded in either case). The difference column in both figures shows the difference between the calculated weighted cost and the LOS-related average cost per disposition for each DRG, in terms of a percentage of the original weighted cost. Thus, for DRG 234 in Table 8, the cost based on the average LOS of 24.71 days was $4,857, an increase of approximately 34 percent over the weighted cost of $3,625. The LOS-related costs per DRG in Table 8 range from 91 percent below to

DRG	Qty	HCFA Weight	Wgtd Cost	Avg LOS	LOS Cost	Dffrnc	Ttl Wgtd Costs	Ttl LOS Costs
234	21	1.2325	$3,625	24.71	$4,857	33.99%	$76,124	$101,995
222	19	0.9794	2,881	13.37	2,628	-8.77%	54,730	49,931
278	18	0.8012	2,356	7.56	1,486	-36.94%	42,416	26,747
231	16	0.9420	2,771	11.06	2,174	-21.54%	44,329	34,782
243	16	0.7473	2,198	11.88	2,335	6.24%	35,166	37,361
232	15	0.6000	1,765	16.47	3,237	83.45%	26,470	48,559
227	12	0.6271	1,844	10.42	2,048	11.05%	22,133	24,577
468	8	2.0818	6,123	43.25	8,501	38.84%	48,983	68,008
256	6	0.8616	2,534	8.67	1,704	-32.75%	15,204	10,225
281	6	0.5321	1,565	8.67	1,704	8.89%	9,390	10,225
233	5	1.7553	5,163	30.20	5,936	14.98%	25,813	29,680
239	5	1.0865	3,196	9.40	1,848	-42.18%	15,978	9,238
248	5	0.6072	1,786	8.60	1,690	-5.35%	8,929	8,452
251	5	0.5902	1,736	4.40	865	-50.18%	8,679	4,324
270	5	0.8039	2,364	6.20	1,219	-48.46%	11,822	6,093
217	4	2.2587	6,643	30.25	5,946	-10.50%	26,572	23,783
247	4	0.6491	1,909	10.50	2,064	8.11%	7,636	8,255
254	4	0.6193	1,821	8.50	1,671	-8.27%	7,286	6,683
224	3	0.8859	2,606	5.00	983	-62.28%	7,817	2,948
253	3	0.7388	2,173	36.33	7,141	228.63%	6,519	21,423
228	2	0.3588	1,055	6.50	1,278	21.07%	2,111	2,555
229	2	0.5936	1,746	6.00	1,179	-32.45%	3,492	2,359
235	2	1.7403	5,118	8.00	1,572	-69.28%	10,237	3,145
236	2	1.3711	4,033	10.00	1,966	-51.26%	8,065	3,931
271	2	1.3659	4,017	13.50	2,653	-33.95%	8,035	5,307
443	2	1.5053	4,427	23.00	4,521	2.11%	8,855	9,042
006	1	0.3952	1,162	5.00	983	-15.45%	1,162	983
008	1	0.7164	2,107	4.00	786	-62.69%	2,107	786
019	1	0.6903	2,030	1.00	197	-90.32%	2,030	197
029	1	0.7100	2,088	1.00	197	-90.59%	2,088	197
215	1	1.4765	4,343	8.00	1,572	-63.79%	4,343	1,572
219	1	1.0678	3,141	3.00	590	-81.22%	3,141	590
255	1	0.4638	1,364	5.00	983	-27.95%	1,364	983
265	1	1.4804	4,354	25.00	4,914	12.86%	4,354	4,914
277	1	0.8771	2,580	3.00	590	-77.14%	2,580	590
285	1	2.8360	8,341	51.00	10,024	20.18%	8,341	10,024
440	1	1.4653	4,310	9.00	1,769	-58.95%	4,310	1,769
461	1	1.6335	4,804	6.00	1,179	-75.45%	4,804	1,179
TTL	204		Average difference			-17.56%	$583,412	$583,412

Weighted average cost $2,941
Average daily cost $197

Table 8: Weighted vs. LOS-derived costs - Orthopedics, 1985
Arithmetic mean LOS

DRG	Qty	HCFA Weight	Wgtd Cost	Geom LOS	Geom Cost	Dffrnc	Ttl Wgt Costs	Ttl Geom Costs
234	21	1.2325	$3,625	11.66	$3,514	-3.05%	$76,124	$73,801
222	19	0.9794	2,881	10.09	3,041	5.58%	54,730	57,781
278	18	0.8012	2,356	5.64	1,700	-27.86%	42,416	30,598
231	16	0.9420	2,771	7.31	2,203	-20.48%	44,329	35,252
243	16	0.7473	2,198	8.70	2,622	19.30%	35,166	41,955
232	15	0.6000	1,765	12.17	3,668	107.86%	26,470	55,021
227	12	0.6271	1,844	7.39	2,227	20.76%	22,133	26,728
468	8	2.0818	6,123	23.18	6,986	14.11%	48,983	55,892
256	6	0.8616	2,534	4.20	1,266	-50.05%	15,204	7,595
281	6	0.5321	1,565	5.42	1,634	4.38%	9,390	9,802
233	5	1.7553	5,163	22.48	6,775	31.24%	25,813	33,877
239	5	1.0865	3,196	7.81	2,354	-26.34%	15,978	11,770
248	5	0.6072	1,786	5.49	1,655	-7.34%	8,929	8,273
251	5	0.5902	1,736	3.73	1,124	-35.24%	8,679	5,621
270	5	0.8039	2,364	4.80	1,447	-38.81%	11,822	7,234
217	4	2.2587	6,643	14.11	4,253	-35.98%	26,572	17,011
247	4	0.6491	1,909	6.70	2,019	5.78%	7,636	8,078
254	4	0.6193	1,821	5.30	1,597	-12.30%	7,286	6,390
224	3	0.8859	2,606	4.93	1,486	-42.97%	7,817	4,458
253	3	0.7388	2,173	19.63	5,916	172.29%	6,519	17,749
228	2	0.3588	1,055	6.00	1,808	71.37%	2,111	3,617
229	2	0.5936	1,746	6.00	1,808	3.58%	3,492	3,617
235	2	1.7405	5,118	6.93	2,089	-59.19%	10,237	4,177
236	2	1.3711	4,033	9.17	2,764	-31.46%	8,065	5,528
271	2	1.3659	4,017	9.59	2,890	-28.05%	8,035	5,781
443	2	1.5053	4,427	15.49	4,669	5.45%	8,855	9,337
006	1	0.3952	1,162	5.00	1,507	29.65%	1,162	1,507
008	1	0.7164	2,107	4.00	1,206	-42.78%	2,107	1,206
019	1	0.6903	2,030	1.00	301	-85.15%	2,030	301
029	1	0.7100	2,088	1.00	301	-85.57%	2,088	301
215	1	1.4765	4,343	8.00	2,411	-44.48%	4,343	2,411
219	1	1.0678	3,141	3.00	904	-71.21%	3,141	904
255	1	0.4638	1,364	5.00	1,507	10.48%	1,364	1,507
265	1	1.4804	4,354	25.00	7,535	73.06%	4,354	7,535
277	1	0.8771	2,580	3.00	904	-64.95%	2,580	904
285	1	2.8360	8,341	51.00	15,371	84.29%	8,341	15,371
440	1	1.4653	4,310	9.00	2,713	-37.06%	4,310	2,713
461	1	1.6335	4,804	6.00	1,808	-62.36%	4,804	1,808
TTL	204	Average difference				-6.67%	$583,412	$583,412

Weighted average cost $2,941
Geometric daily avg cost $301

Table 9: Weighted vs. LOS-derived costs - Orthopedics, 1985
Geometric mean LOS

229 percent above their equivalent weighted costs. The average variation across the entire set of comparisons was -17.56 percent. When calculated from the geometric mean (Table 9), the same costs per DRG came somewhat closer, ranging from 86 percent below to 172 percent above their equivalent weighted costs. The overall average variation of -6.78 percent was also smaller in absolute magnitude than that for Table 8. The costs based on the geometric mean approximate those calculated from the HCFA weights more closely than do those based on the arithmetic mean. However, both show a relatively large variation from the corresponding weighted DRG costs. The elimination of outliers in both sets of calculations would probably reduce this variability, but only at the expense of the loss of potentially valuable information. How best to include "outliers" in any cost calculation scheme is a matter which still needs to be resolved.

Discussion and Implications

In order to be truly useful as a management tool, any system for analyzing the costs of delivering patient care within a given facility should (1) employ standardized patient classifications which are clinically coherent and homogeneous with respect to resource consumption, (2) predict within an acceptable confidence interval the resource consumption within each category, and (3) account for all dollars spent in the provision of patient care at the facility.

The problem of assigning patients into manageable groups is one of striking a balance between the conflicting requirements of clinical clarity and ease of data manipulation. On the one hand, absolute clinical accuracy would probably require the utilization of thousands of different groups, in

order to reflect the full spectrum of patient conditions and the procedures available to manage them. But attempting to work all of these possible groupings into a management system would be unwieldy and unworkable. On the other hand, the utilization of too few groups creates the risk of failing to provide sufficient precision to make the data meaningful to decision makers.

With its 470 diagnosis related groups, the DRG system appears to offer a reasonably workable compromise. It is not without drawbacks, however, one of the most serious of which is that it does not readily recognize differing degrees of intensity within individual DRGs. Some recognition can be given to the requirement for additional resources to treat certain patients by employing cutoff points such as HCFA's outliers, beyond which additional dollars are added on a per diem or other basis to the calculated DRG costs. But the identification of such patients complicates the data-gathering and calculation process considerably. There are also situations, such as with DRG 232 in the study sample, where the distribution of patient LOS appears in fact to be bimodal. Merely treating patients grouped about an upper mean as outliers could be inaccurate or even misleading, compared to what is actually happening within that DRG. The possible presence of bi- or other multi-modal LOS distributions in a single DRG brings into question one of the basic premises around which the entire system was structured--that the patient conditions included in that DRG are reasonably homogeneous with regard to resource consumption during their hospitalization. One study published in the Journal of the American Medical Records Association suggests that, while LOS in certain DRGs do fall into a reasonably "mound-shaped" distribution, there are a number of others which appear to exhibit bi- or multimodality. Therefore there will inevitably be economic heterogeneity, to some extent, within many DRGs.(3) The question becomes one of how much heterogeneity is acceptable for the purpose at hand.

Another problem concerns patient conditions which do not fit well into any DRG under the present classification scheme, an example of which are the obstetric patients in DRG 467. The grouping algorithm, unable to place them anywhere else, assigns these patients into DRG 467 as a last resort. The weight of 0.9697 is grossly inappropriate for the resource consumption actually associated with this DRG (as it applies to this service). The revised weight of 0.0725, while more in keeping with the probable actual expenses, is also a 13-fold reduction! Either the assignment algorithm is flawed, the weight attached to the DRG is inappropriate, or there simply is no proper DRG for this situation. The latter appears to be the most likely explanation, since what actually takes place within this DRG, essentially, is an outpatient procedure (in terms of resource intensity) in an inpatient setting.

A number of other patient classification systems(4) have been proposed as alternatives to DRGs, all of which claim to be more useful, more accurate, or both. None have gained the widespread acceptance enjoyed (albeit with HCFA's insistence) by the DRG system, but they may be worth considering as part of the continuing search for the optimum system to use in military facilities. It is beyond the scope of this paper to delve very deeply into the subject of alternative classification systems. Suffice it to say that, although DRGs do not yet constitute the final answer, they have proven to be a reasonably workable approach to the classification problem, with definite promise for application in military facilities, too, even though some modification may be required.

Once patients have been grouped appropriately, the next requirement is to ensure that the resource consumption within each group (DRG) is defined in comparison to that experienced in the other groups. The weights

assigned by HCFA to each DRG represent proportions of a given reference cost. They were calculated by converting the sums of the average costs per DRG for routine care (per diem cost times bed days), special care (per diem cost times bed days), and ancillary care (number of procedures times the unit cost for each) for each DRG, to percentages of a facility-wide weighted average cost. In order to create a nationwide system, these costs were then averaged and adjusted to accomodate regional labor differentials, the cost of teaching programs, etc., as well as to maintain HCFA budget goals (such as the 1985 reduction of all of the weights by 1.05 percent).

A most difficult problem in military health care facilities, where expenditures are not linked to individual patient records in any way, is determining the actual cost of treating a particular patient or DRG. This can be reasonably approximated using an appropriate weight for each DRG, obtained in any one of several possible ways. To begin with, one could simply accept the HCFA weights on faith, assuming that they reflect the comparative resource consumption for each DRG adequately. This is the approach, with the single exception of DRG 467 in Obstetrics, which was followed in the completion of the research reported in this paper. One could recalculate the weights by examining as did HCFA the separate cost components of each DRG and making any adjustments necessary to improve their accuracy for military facilities. Or one could devise a means of measuring the actual cost of the patient care rendered and compare it with the costs previously calculated using a weighting system. The author had hoped at the outset of the project to be able to do this for the two services addressed in the study, but it proved not to be possible within available time and expertise constraints. It would still be a productive field for future investigation.

The final requirement for any cost accounting system is ensuring that all dollars expended have been properly identified and accounted for. This is the purpose of the UCA. However, certain changes in the system might be necessary in order to ensure that all appropriate expenses are captured and allocated in an accurate and usable manner. For example, intensive care is treated as a final operating account under the UCA, but its patients generally bear cost center codes for clinical services such as Internal Medicine, Cardiology, or General Surgery. Upon admission to the ICU, their UCA cards are supposed to be changed to reflect their assignment to the ICU cost center; however, this does not occur consistently. As a result, the expenses of providing special care to patients go in two directions: those associated with individual care (such as laboratory tests) may be charged either to the respective clinical services or to the ICU, while those associated with the operation of the unit itself are charged to the ICU. Thus, costs are artificially depressed in the affected clinical services, and incompletely described for the ICU. It would appear more logical to make the ICU a cost pool similar to all other wards in the hospital with its expenses reallocated among the various clincial services from which the patients actually come.

One final point should be emphasized. Any retrospective cost-finding system must begin with the actual expenses experienced by or attributable to the clinic service in question. Facility-wide average rates may be fine for a prospective payment system, but a discussion of actual costs demands that calculations begin with service-specific costs instead. The two different weighted average cost figures which emerged from Obstetrics and Orthopedics during the study demonstrate this point unmistakably. Otherwise, such subtleties as the effects of increased LOS on the costs associated with many Orthopedics patients would be lost.

Homogeneity of Clinical Services

As the author collected patient admission data, it became apparent that the assignment of patients to UCA cost centers followed remarkably consistent trends during the study period. Upon investigation, it was discovered that the Admissions and Dispositions clerks follow a certain protocol which specifies the UCA accounts to which all patients will be assigned, according to their clinical service and their status as pediatric, adult or family practice patients. A copy of this protocol is reproduced in Appendix C. However, the presence of occasional conflicts between IPDS and UCA clinical services in the study sample indicates that the assignment process apparently does not lead to the expected result all of the time. Accordingly, a confidence interval was sought for the assignment of a patient with a known IPDS clinic service to the predicted UCA cost center.

The patients admitted to MACH can be considered to belong to a binomial population, where a success corresponds to an assignment which proceeds as expected, and a failure to one which does not. Out of the total of 2,543 patients in the study sample, 2,399 were assigned to the UCA cost centers specified in the assignment protocol. The proportion of patients assigned to predicted cost centers was:

$$f = \frac{2399}{2543}, \quad \text{or } 0.943.$$

The standard error of the proportion becomes:

$$Sf = \sqrt{\frac{(.943)(0.057)}{2543}}, \text{ or } 0.0000211. \quad (5)$$

If Z for alpha = 0.05 (two-tailed) is 1.96, then the 95 percent confidence interval for the proportion of assignments that will come out as expected

becomes (with a continuity correction for the normal approximation technique used here)

$$L(1) = f - Z_{\frac{\alpha}{2}} Sf - \frac{1}{2(2543)},$$

and (6)

$$L(2) = f + Z_{\frac{\alpha}{2}} Sf + \frac{1}{2(2543)}.$$

For this situation, the 95 percent confidence interval is defined by 0.943 +/- 0.000238. This suggests that one can be 95 percent confident that approximately 6 percent of the patients will not be assigned to the predicted cost center or, conversely, that just over 94 percent will.

Several changes were made during the quarter which might have caused a larger number of UCA code assignments to go awry than would normally be expected. An ENT specialist was assigned to the hospital during the period of the study, and there was some initial turbulence in the cost centers to which his patients were assigned. Admissions and Dispositions personnel also began assigning upper respiratory infection patients to Pulmonary Medicine instead of General Medicine. The only IPDS clinic services which do not lead to only one UCA cost center are those which apply to certain Pediatrics and Family Practice patients with problems that fall into the subspecialties of internal medicine. This problem would be ameliorated by assigning all Family Practice medical patients to Family Practice Medicine (AAAF) and all pediatric patients to either Pediatric Medicine (ADAA) or Pediatric Surgery (ABHA) and ignoring any further delineation of subspecialties. The numbers of patients involved are so few that they have little practical relevance anyway. Therefore, one can consider that, for all practical purposes, the clinic services in the two systems can be matched straight across, at least when converting IPDS to UCA clinical

services. The converse is not necessarily true. In addition to the prevailing confusion with certain pediatric and family practice patients, Internal Medicine (AAAA under the UCA) includes two IPDS services--AA (Internal Medicine), and AU (Infectious Disease).

FOOTNOTES

1. U.S., Department of the Army, "Health Service Regions and Health Service Areas," HSC Regulation 40-21 (10 November 1983), p. 2-4.

2. U.S., Department of the Army, Uniform Chart of Accounts Procedures Manual (6 August 1979), Chap. II passim.

3. Paul L. Grimaldi and Julie A. Micheletti, "Homogeneity Revisited: The New DRGs," Journal of the American Medical Records Association (April 1982), pp. 56-70.

4. In addition to several DRG-based case mix classification systems, the following patient severity/case mix classification systems have been advertised in recent months: MediQual Systems, Inc., Medical Illness Severity Grouping System (MEDISGRPS), Westborough, Massachusetts, and Chicago, Illinois; Susan D. Horn, Center for Hospital Finance and Management, Johns Hopkins University, Severity of Illness Index, Baltimore, Maryland; Systemetrics, Disease Staging, Santa Barbara, California; Health Data Institute, Appropriateness Evaluation Protocol, Newton, Massachusetts; Blue Cross of Western Pennsylvania, Patient Management Categories, Pittsburgh, Pennsylvania.

5. David V. Huntsberger, Elements of Statistical Inference (Boston: Allyn and Bacon, 1967), pp. 158-60.

6. Ibid, pp. 169-72.

III. CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Based on the sample calculations performed for Obstetrics (including Family Practice Obstetrics) and Orthopedics at Martin Army Community Hospital, the methodology for calculating average costs per DRG at military hospitals, using UCA-supplied total cost figures for each service and the HCFA DRG weights is both practical and workable, as long as the following conditions can be met:

1. The UCA captures and reports total expenses at the clinic service level completely and accurately

2. IPDS clinic services can be matched directly to equivalent UCA cost centers

3. All patients in each clinic service can be grouped into appropriate DRGs

Of the methodologies examined for accomplishing these cost calculations at MACH, the application of service-specific weighted average costs to standardized DRG weights (such as those published by HCFA) appears to come the closest to describing the actual average resource expenditure within each DRG. Comparisons with the civilian sector indicated that average costs for inpatient obstetric care at MACH were approximately 13 percent lower, and those for orthopedic care approximately 18 percent higher than average costs for comparable care at local civilian hospitals. Since identical DRG weights were used in the various cost computations, these differences are the direct result of variations between the standard facility rates used to calcuate civilian reimbursements and the

service-specific average weighted costs upon which the MACH costs were based.

There are two major considerations which impact upon any discussion of cost comparisons between military hospitals such as MACH and the civilian sector. First, the MACH cost figures are derived from actual current costs, while the average civilian reimbursements have more to do with anticipated revenue than with actual costs. It stands to reason that reimbursements must exceed costs by some margin. If not, the hospital takes on a certain loss anytime it admits a patient likely to fall into a DRG where this is not the case. Hospitals that do that with too many of their patients do not stay in business. This might explain the favorable cost differential that MACH enjoys in the obstetrical DRGs, compared to average civilian reimbursements. The second point is that large differences between average LOS at MACH and the HCFA averages for the same DRGs will also result in a cost differential between MACH and civilian providers. The fact that average LOS in Orthopedics were nearly twice the HCFA figure for many DRGs might go a long way towards explaining the considerably higher average costs per DRG at MACH for orthopedic care.

The fact that LOS-derived costs per DRG varied as widely as they did from those calculated using HCFA weights in the obstetrical services, where average LOS were very close to the HCFA averages, would seem to confirm that the LOS is not a sufficient predictor of resource utilization to enable its use <u>in isolation</u> in the calculation of costs per DRG. However, LOS data can offer valuable information, particularly in DRGs where the number of outliers is sufficiently high to suggest bi- or other multimodality in the LOS distribution.

In order to enable the most accurate cost estimates to be obtained,

the weights for each DRG need to be examined closely. Certainly, the weight assigned to DRG 467, at least as presently applied in both obstetrical services, should be reduced to a point far below its current HCFA value.

Recommendations

Several changes are necessary to facilitate the calculation of costs per DRG at a military facility such as MACH on a routine basis. They are:

1. Change over as soon as possible to the ICD-9-CM coding system, instead of the ICD-9 system which is presently used. This will bring military facilities in step with the rest of the health care industry, and greatly facilitate the routine grouping of patients into DRGs.

2. Change the UCA cost centers for medical and surgical intensive care into cost pools instead of final operating accounts, consistent with the handling of all other inpatient wards in the facility.

3. Modify the protocol for the assignment of patients to UCA cost centers to enable the direct matching of IAS clinical services with UCA final operating accounts. A recommended protocol for this purpose appears in Table C-2 in Appendix C.

APPENDIX A
Derivation of Adjusted UCA Direct Costs

General

Since capital and depreciation costs are not included in the DRG prices under the HCFA Prospective Payment System, certain support costs included by the UCA in its own total cost figures must be identified and excluded for the purpose of this study. This ensures that the costs calculated per DRG at MACH are as equivalent as possible to those for the same DRGs under PPS calculations. The MACH support costs identified for exclusion include:

UCA Cost Ctr	Definition
EAYA	Inpatient Depreciation
ECAA	Fire Protection
EDEA	Other Engineer Support
EDCA	Maintenance of Real Property
EDDA	Minor Construction
EBYK	Other Base Operations Functions

For the purpose of this study, Clinician salaries were also subtracted, since physician fees are not covered under PPS. The identification and subtraction process is summarized for each of the two major services on the following pages.

Table A-1
Regular (ACBA) and Family Practice (ACBF) Obstetrics
Direct Cost Adjustments

Cost Center Adjustments

	ACBA	ACBF
Inpatient Depreciation	$7,137	$910

Cost Pool Adjustments

1. Starting figures:	Wards F Med	F Srg	Pst-Ptm	L&D
Fire Protection	14	13	10	9
Maint of Real Prop	177	177	134	112
Minor Construction	2,121	2,107	1,596	1,336
	$2,312	$2,297	$1,740	$1,457
2. Proportional Allocations:				
Total	$151,555	$142,950	$152,784	$161,534
ACBA Costs	540	3,558	99,329	143,265
Proportion of Total	0.0036	0.0249	0.6501	0.8869
ACBF Costs	0	742	12,663	18,264
Proportion of Total	0.0000	0.0052	0.0829	0.1131
3. Conversion to Dollar Adjustments:				
ACBA	$8	$57	$1,131	$1,292
ACBF	0	12	144	165

Summary of Adjustments

	ACBA	ACBF
Direct to Cost Center	7,137	910
Cost Pool Shares		
Female Medical Ward	8	0
Female Surgical Ward	57	12
Post-Partum Ward	1,131	144
Labor and Delivery	1,292	165
Total Direct Cost Adjustments	**$9,626**	**$1,231**

Table A-2
Regular (AEAA) and Family Practice (AEAF) Orthopedics
Direct Cost Adjustments

Cost Center Adjustments

	AEAA	AEAF
Inpatient Depreciation	$21,145	$0

Cost Pool Adjustments

1. Starting Figures:	F Srg	M Srg	Wards/Clinics Ort Wd	Ort Cl
Fire Protection	13	13	24	9
Maint Real Prop	177	177	310	126
Minor Const	2,107	2,107	3,690	1,493
Total	$2,297	$2,297	$4,024	$1,628
2. Proportional Allocations:				
Total	$142,950	$178,745	$280,556	$85,585
AEAA Costs	445	472	242,949	8,766
Proportion of Total	0.0031	0.0026	0.8660	0.1024
AEAF Costs	0	0	0	0
3. Conversion to Dollar Adjustments:				
AEAA	$7	$6	$3,485	$167
AEAF	$0	$0	$0	$0

Summary of Adjustments (AEAA and AEAF combined):

Direct to Cost Center	21,145
Cost Pool Shares	
Female Surgical Ward	7
Male Surgical Ward	6
Orthopedic Wards	3,485
Orthopedic Clinic	167
Total Direct Cost Adjustments	**$24,810**

Table A-3
Final Calculations Summary

Obstetrics

	ACBA	ACBF
Direct Expenses	$25,430	$10,824
Support Costs	43,147	5,511
Ancillary Costs	115,979	5,769
Net Purification	246,896	31,688
Purified Expense	**$431,452**	**$53,792**
Adjustments		
Direct Cost Adjustments	**-9,626**	**1,231**
Clinician salaries	**-32,266**	**-3,988**
Adjusted Direct Costs	**$389,560**	**$48,573**

Orthopedics (AEAA and AEAF combined)

Direct Expenses	$21,889	
Support Costs	99,164	
Ancillary Costs	256,180	(incl *$400 for AEAF)
Net Purification	252,878	
Purified Expense	**$630,111**	
Adjustments		
Direct Cost Adjustments	**-21,145**	
Clinician salaries	**-21,889**	
Adjusted Direct Costs	**$583,412**	

*The only expense charged to AEAF in the entire MEPR.

APPENDIX B
Derivation of the MACH Standard Rate

The HCFA methodology for the calculation of the beginning standard rate begins with the Medicare-allowable direct costs for the base year. For MACH, this base year cost was obtained by performing essentially the same adjustments described in Appendix A on the total inpatient cost figures for fiscal year 1983. The summary appears below:

Cost of Inpatient Care	$16,263,000
Less Adjustments:	
Inpatient Depreciation	-268,750
Fire Protection	-711
Other Engineer Support	-12,279
Minor Construction	-3,598
Other Base Operations Functions	0
Clinician Salaries	-761,762
Adjusted Total Cost	$15,215,900

This adjusted total cost was divided by the total dispositions recorded by the UCA for the same time period, to obtain the "base year cost," or the average cost per disposition for the base year.

$$\$15,215,900 / 12,140 = \$1,253.37$$

This "base year cost was divided by the case mix index for the facility for that same year, and then multiplied by the updating factors for fiscal year 1984 and fiscal year 1985:

$$\frac{\$1,253.37}{0.7146} \times 1.3570 \times 1.05878 = \$2,520$$

For fiscal year 1985 calculations, 50 percent of this figure was combined with a regional/federal figure obtained from the following formulas:

Regional: [(Area wage index x region-specific labor component) + regional-specific non-labor component] x 75 percent x 50 percent.

[(0.9180 x $2,296.98) + $612.75](0.75)(0.5) = $1,020.52

Federal: [(Area wage index x federal labor component) + federal non-labor component] x 25 percent x 50 percent.

[(0.9180 x $2,320.01) + $664.44](0.25)(0.5) = $349.27

The final standard rate combines these three figures:

Hospital component	$1,260
Regional component	1,020
Federal component	349
Facility Standard Rate	**$2,629**

APPENDIX C

Table C-1
UCA-IPDS Matching Protocol (Present)

IAS Code	UCA Code	Clinical Service
MEDICAL		
AA	AAAA	Internal Medicine
AU	AAAA	Infectious Disease
AN	AAAC	Allergy
EA	AAAF	Internal Medicine Family Practice
AB	AABA	Cardiology
EA	AABF	Cardiology Family Practice
AD	AADA	Dermatology
EA	AADF	Dermatology Family Practice
AF	AAFA	Gastroenterology
EA	AAFF	Gastroenterology Family Practice
AA	AAHA	Medical Intensive Care
EA	AAFH	Medical Intensive Care Family Practice
AJ	AAJA	Neurology
EA	AAJF	Neurology Family Practice
AK	AAKA	Oncology
AL	AALA	Pulmonary/Upper Respiratory Disease
EA	AALF	Pulmon/Upper Resp Dis Family Practice
SURGICAL		
BA	ABAA	General Surgery
EB	ABAF	General Surgery Family Practice
HA	ABEA	Ophthalmology
BE	ABFA	Oral Surgery
BF	ABHA	Pediatric Surgery
EB	ABHF	Pediatric Surgery Family Practice
BH	ABJA	Proctology
EB	ABJF	Proctology Family Practice
BI	ABKA	Urology
EB	ABKF	Urology Family Practice
HB	ABGA	ENT (Otorhinolaryngology)
BN	ABAA	Peripheral Vascular Surgery
OBSTETRICAL AND GYNECOLOGICAL		
CA	ACAA	Gynecology
ED	ACAF	Gynecology Family Practice
CB	ACBA	Obstetrics
EC	ACBF	Obstetrics Family Practice
PEDIATRIC CARE		
DA	ADAA	Pediatrics
EF	ADAF	Pediatrics Family Practice
DB	ADBA	Newborn Nursery
DB	ADBF	Newborn Nursery Family Practice

Table C-1 (Cont)
UCA-IPDS Matching Protocol (Present)

ORTHOPEDIC CARE		
FA	AEAA	Orthopedics
EG	AEAF	Orthopedics Family Practice
FB	AEBA	Podiatry
FB	AEBF	Podiatry Family Practice
PSYCHIATRIC CARE		
GA	AFYA	Psychiatric Care
GA	AFYF	Psychiatric Care Family Practice

Table C-2
UCA-IPDS Matching Protocol (Proposed)

IAS Code	UCA Code	Clinical Service
MEDICAL		
AA	AAAA	Internal Medicine
AU	AAAA	Infectious Disease
AN	AAAC	Allergy
AB	AABA	Cardiology
AD	AADA	Dermatology
AF	AAFA	Gastroenterology
AJ	AAJA	Neurology
AK	AAKA	Oncology
AL	AALA	Pulmonary/Upper Respiratory Disease
EA	AAAF	All Medicine Family Practice
SURGICAL		
BA	ABAA	General Surgery
EB	ABAF	General Surgery Family Practice
HA	ABEA	Ophthalmology
BE	ABFA	Oral Surgery
BF	ABHA	Pediatric Surgery
EB	ABHF	Pediatric Surgery Family Practice
BH	ABJA	Proctology
EB	ABJF	Urology
EB	ABKF	ENT (Otorhinolaryngology)
BN	ABAA	Peripheral Vascular Surgery
OBSTETRICAL AND GYNECOLOGICAL		
CA	ACAA	Gynecology
ED	ACAF	Gynecology Family Practice
CB	ACBA	Obstetrics
EC	ACBF	Obstetrics Family Practice
PEDIATRIC CARE		
DA	ADAA	Pediatrics
EF	ADAF	Pediatrics Family Practice
DB	ADBA	Newborn Nursery
DB	ADBF	Newborn Nursery Family Practice
ORTHOPEDIC CARE		
FA	AEAA	Orthopedics
EG	AEAF	Orthopedics Family Practice
FB	AEBA	Podiatry
FB	AEBF	Podiatry Family Practice
PSYCHIATRIC CARE		
GA	AFYA	Psychiatric Care

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